Mackenzie Timber Supply Area

Vegetation Resources Inventory

Strategic Inventory Plan

October 18th, 2005

EXECUTIVE SUMMARY

This Vegetation Resources Inventory (VRI) Strategic Inventory Plan (VSIP) outlines the VRI activities and products that address forest management and inventory issues in the Mackenzie Forest District (DMK), as identified at the November 21, 2000 stakeholders meeting. The stakeholders included the Ministry of Forests, Ministry of Environment Lands and Parks, Abitibi Consolidated Inc., and Slocan Forest Group Inc.

The stakeholders identified the following VRI activities and products in 2000 and while the stakeholders have made excellent progress towards satisfying these issues, each point below remains today;

1. Conduct a Phase I photo-interpretation over the entire District. The Phase I database will support timber-emphasis inventories, habitat mapping, Ecosystem mapping, riparian mapping, and other applications over the district.

2. Conduct timber emphasis ground sampling in the Vegetated Treed area of the District to provide statistically valid timber volumes and polygon-specific tree attributes for the timber supply review in the Mackenzie TSA in 2006. (which has now been deferred to 2010) The ground sampling will include Net Volume Adjustment Factor (NVAF) sampling to check loss factors and taper equations in the balsam leading stands, and to check taper equations in the small pine stands.

3. Conduct finer polygon delineation and timber emphasis ground sampling in the deciduous stands and mixed-deciduous stands in the DMK to improve species composition descriptions and spatial data for these stands.

4. Install a monitoring program in the DMK to provide baseline non-spatial data for monitoring the changes and trends over time of timber and non-timber resources. These data could be used to check growth and yield predictions and to support future market certification requirements.

The approximate number of ground sample plots and costs for the proposed VRI activities are given in Table 7 of this report.

These VRI activities and products will support the District objectives and other resource specific interpretations. They may be implemented in smaller units (e.g., Management Zones) across the District. They may also be jointly implemented to address common District issues within the Northern Interior Forest Region.

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1. INTRODUCTION

1.1 Background

This Vegetation Resources Inventory (VRI) Strategic Inventory Plan (VSIP) outlines VRI activities and products needed to address forest management and inventory issues in the Mackenzie Forest District (DMK), as identified by stakeholders at the November 21, 2000 meeting. The VSIP provides details for photo interpretation, timber emphasis ground sampling, and monitoring sampling in the DMK. This strategy, while supported by all the stakeholders listed in Table 8, is the focus of Abitibi Consolidated, Mackenzie Region. After VSIP approval, the next steps are the preparation of project implementation plans (VPIPs) based on this VSIP, and the implementation of the VPIPs. The previous VSIP for the Mackenzie TSA had included retrofit as an option, but that opportunity has now lapsed.

1.2 VRI Overview

The VRI is a new vegetation (forest) inventory process that has been approved by the Resources Inventory Committee (RIC) to assess the quantity and quality of BC's timber and vegetation resources. The VRI estimates overall population totals and averages, as well as individual polygon attributes, for timber and non-timber resources. Its design is simple, reasonably efficient, statistically defensible, and addresses issues raised by the Forest Resources Commission it its 1991 report, *The Future of Our Forests*.

The VRI consists of several components (Appendix II):

1. BC Land Cover Classification Scheme (BCLCS)
2. Photo Interpreted Estimates (Phase I)
3. Ground Sampling (Phase II) –timber emphasis, ecology, coarse woody debris
4. Net Volume Adjustment Factor (NVAF) sampling
5. Within Polygon Variation (WPV) sampling
6. Statistical Adjustment

One or more of these components can address specific forest management or inventory issues. An overview of the VRI design was presented at the stakeholder meeting. For more information, VRI manuals are available on the Internet at
http://srmwww.gov.bc.ca/tib/fia/vri.htm

1.3 VRI Planning

The VRI planning process for management inventories, develops VSIPs and VRI project implementation plans (VPIPs) for defined areas, e.g. a Forest District. A VSIP outlines VRI products to address forest management issues and provides strategic direction for implementing the District inventory activities. A VPIP details the operational activities identified in the VSIP (e.g., ground sampling or photo interpretation projects) and identifies project areas, priorities, plot location, yearly inventory costs, and roles and responsibilities. Guidelines for preparing the VSIPs and VPIPs are available on the Internet at
http://srmwww.gov.bc.ca/tib/fia/vri.htm

VSIP: Mackenzie Forest District

The VRI planning process for management inventories (points 2-4 noted below) is an important component of the overall VRI process and related activities. The intent of the VRI planning process is to ensure that baseline products meet a range of applications and are efficiently implemented. These processes and activities include:

1. Forest management decision processes (land integration planning)

2. Identifying forest management issues

3. VRI Strategic planning (VSIP)

4. VRI District operational planning (VPIPs)

5. Implementation, including development and maintenance of procedures and standards:

    a) Management inventories
    b) Database management

6. Data interpretation, including ecosystem and habitat mapping

The steps for preparation of a VSIP include:

1. The licensee stakeholders to develop Issues Statements related to VRI.

2. The licensee stakeholders work with Forest Analysis and Inventory Branch to prepare a VRI "Forest Management and Inventory Issues Discussion Paper".

    This paper explains the VRI process and identifies key issues known to date. Issues are usually taken from the Timber Supply Review Data Package, plus any other issues identified by stakeholders in Step 1. This discussion paper is circulated before the VSIP meeting.

3. A VRI Stakeholders meeting held. The functions of this meeting are to:
    - Introduce the VRI tools and process
    - Table new issues and issues recorded to date
    - Discuss issues that can be funded or not (under current funding mechanisms); this discussion provides general direction for developing the VSIP. This discussion also affects the extent of photo interpretation and the number and type of VRI plots done where.
    - Suggest the VRI tools to address currently fundable issues as well as those issues that may be funded in the future.

4. VRI Stakeholder meeting minutes are prepared and circulated to all participants for review and feedback.

5. A preliminary VSIP is prepared by the licensee stakeholders and discussed by the stakeholders at a conference call.

6. A final VSIP is prepared by licensee stakeholders.

7. The VPIP process starts.

The steps for preparation of a VPIP include:

1. Review and update VSIP recommendations
2. Secure funding
3. Identify project activities, geographic areas and costs
4. Specify roles and responsibilities for project implementation
5. Prepare VPIP

1.4 Funding

Stakeholders, develop criteria for setting VRI activity priorities and products identified during the planning process. Inventory funding, or follow-up resource-specific management interpretations, is excluded from the planning process since funding mechanisms vary. Currently, funding for VRI activities is FIA eligible.

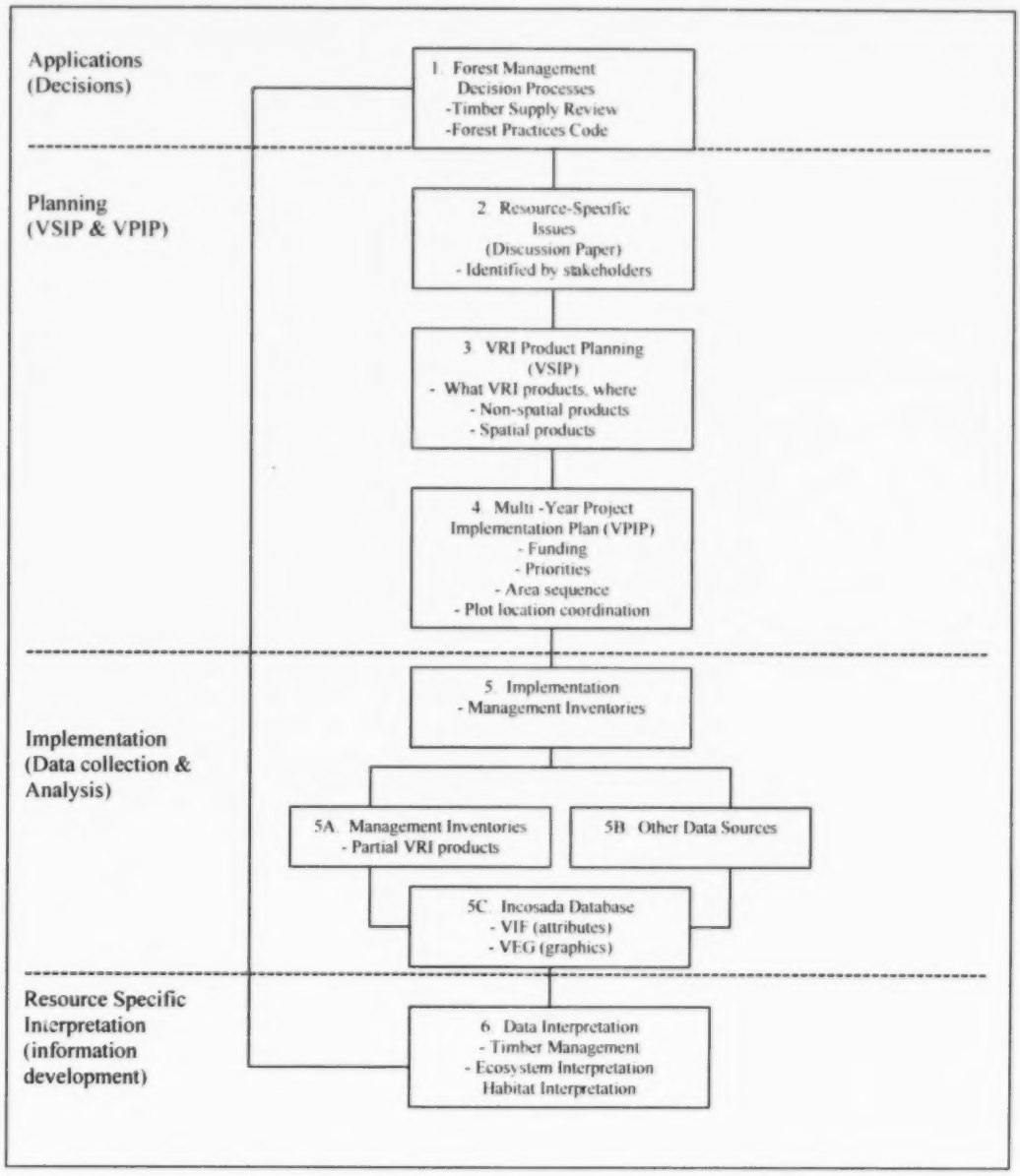

Figure 1. The VRI management inventory process.

2.1 Landbase

The DMK is approximately 6.4 million ha, of which about 3.4 million ha are forested (Table 1). The main tree species in the forested landbase are Lodgepole Pine (37%), Spruce (32%), Balsam (25%), and deciduous (6%) (Table 2). We assume in this report that the forested landbase corresponds to the Vegetated Treed (VT) landbase (BC Landcover Classification Scheme, or BCLCS).

Table 1. DMK landbase by forest cover.[2]

Forest Cover	Area (ha)	%
Forested	3,391,447.30	52.9
Mature	2,305,845.70	35.9
Immature	943,419.90	14.7
NSR	97,601.80	1.5
Non commercial	44,579.40	0.7
No typing available	0.4	0.0
Non productive	3,022,875.10	47.10
Grand Total	**6,414,311.40**	**100.0**

2.2 Forest Management Considerations

Significant forest management issues in the Mackenzie TSA (and pertinent to the DMK) were highlighted in the timber supply review data package Table 3). Use of the VRI to address these issues is identified in Table 3 but the relative importance of the VRI on these issues is not indicated. For example, it does not show that a statistically accurate timber volume estimate may be more relevant than all other issues combined. Yet completing a VRI is considered by the forest industry to be a critical project in the Mackenzie.

Table 2. DMK forested landbase by species

Leading Species	Area (ha)	%
Lodgepole Pine	1,240,700.90	36.6
Spruce	1,068,077.20	31.5
Balsam	843,541.00	24.9
Aspen	207,341.90	6.10
Birch	23,471.80	0.70
Cottonwood	8,235.20	0.20
Other*	75.60	0.0
No species label	3.50	0.0
Grand Total	**3,391,447.30**	**100.00**
*Douglas Fir, Cedar, Hemlock and Larch		

The following emerging data needs were considered at the stakeholder meeting:

1. Park inventories
2. Check growth and yield predictions
3. Meet market certification requirements

[2] Data from the new TSR database using the new District boundary; the data summaries were provided by Jennifer Pollard, Data Administrator/GIS Analyst, MOF, Prince George Forest Region.

Table 3. Forest management issues and the use of the VRI to address issues in the DMK.

Issue[3]	VRI Implication: Photo Interpretation (Phase I)	VRI Implication: Ground Sampling (Phase II)	Remarks
1. Stand -level volume estimates: ensure that data supporting TIPSY reasonably estimate regenerated stand volumes in the TSA	Required	Required	Volume estimates from a monitoring program or VRI could provide immature stand data to check TIPSY estimates.
2. Operability criteria: re-examine operability and merchantability criteria in light of the re-inventory.	Required	Required	VRI may provide additional inventory information to assist the examination of these criteria.
3. TSA inventory: conduct re-inventory of landbase, particularly northern portion.	Required	Required	VRI photo-interpretation and ground sampling will provide updated inventory information for the landbase. The photo-interpretation inventory is incomplete, and the volumes are inaccurate (according to the inventory audit.)
4. Non-recoverable losses: re-examine unsalvaged losses from the Fort Ware fire and forest health.	Required	Required	VRI ground sampling may provide additional information on un-salvaged losses from health (Balsam, Spruce, Pine beetles); the data are needed as inputs to risk rate models.
5. Archaeological assessment: incorporate archaeological information into next TSR	Required	required	There is potential to use VRI data in modeling.
6. Proposed Protected Areas: consider effects of protected areas on TSR determination	Required	Required	Spatial adjusted or unadjusted data and land classifications from VRI could help in delineation of protected areas.
7. Deciduous stands: improve inventory and spatial timber distribution of these stands.	Required	Required	VRI photo-interpretation and ground sampling will provide a better inventory of deciduous stands.
8. Grazing: consider new grazing opportunities and maintain existing grazing tenures	Required	Required	Plant lists and spatial data from VRI may help to identify new grazing opportunities.
9. Botanical forest resources: maintain the opportunity for the sustainable use of botanical forest products such as wild berries, mushrooms and medicinal plants.	Not required	Required	See Issue #8.

[3]Issues compiled from: (1) Timber Supply Branch. 2000. Forest Management Issues Identified Through AAC Determination Process. District/TFL Timber Supply Reviews: 1992-1996 (revised). (2) Land Use Coordination Office.2000. Mackenzie Draft Recommended Land and Resource Management Plan and (3) stakeholder input.

VSIP: Mackenzie Forest District

VRI Implication

Issue[3]	Photo-Interpretation (Phase I)	Ground Sampling (Phase II)	Remarks
10. Landscape unit planning and stand-level biodiversity: assist Forest Practices Code land management planning decision processes, LRMP resource management zones delineation and management prescriptions.	Required	Required	Spatial data from photo-interpretation and plant lists, forage production, lichen production and shrub transects from ground sampling may provide additional information for riparian area designation, wildlife tree patches, coarse woody debris levels, seral stage distribution, successional effects, ungulate winter ranges. The sampling design employed (plot types and distribution) affects the degree of plot support for ecosystem, habitat mapping and SIBEC. Some supplemental sampling may be needed to pick up areas missed.
a). Caribou habitat: area within Area Specific Caribou Management Strategy #1 (LRMP, see appendix D) is a priority; mainly associated with Pine types	Required	Required	VRI photo-interpretation and ground sampling may help to interpret caribou habitat using a range of attributes (crown closure, age, tree height, site index and duff layer, ground lichen presence and % cover)
b). Grizzly bear habitat: Forest /district habitat mapping with primary issue areas are:	Required	Required	Photo-interpretation will provide a polygon base for ecosystem mapping. Ground sampling: no specific stratum identified. Use stratum sampled with plot types Q, V and Z, put in to address other issues.
c). High and Spring use grizzly bear habitat (LRMP, see page 71 and appendix F)			Supplement later with post VRI sampling.
d). Rare plant associations: 3 blue-listed plant associations: Subalpine Fir-Black Spruce/Labrador TEA PA (within ESSF mv2/03,mv3/03,mv4/03) Subalpine Fir/ Alder/ Horsetail PA (within ESSF mv4/05) Black Spruce/Black Huckleberry/Coltsfoot PA (within SBPS mc/03, SBS mc2/03, mc3/05, mc3/06, wk2/04, mk1/06, mk2/04)	Required	Required	Photo-interpretation will provide a polygon base for ecosystem mapping. Ground sampling will provide plot data to support ecosystem mapping. Use VRI-based ecosystem mapping as a coarse filter interpretation to identify areas of potential for these occurrences and conduct follow up inventory.
e) Old growth/ biodiversity guidelines for the Forest District: priority area is the ESSF zone in the eastern (high grizzly use) portion of the district.	Required	Required	Better identification of old growth from VRI to answer the timber age question (250 year for old). Potential to use VRI to define old growth based upon attributes in addition to age.
g). Seral stage diversity for biodiversity implementation	Required	Required	

VRI Implication

Issue[3]	Photo-Interpretation (Phase I)	Ground Sampling (Phase II)	Remarks
11. Succession effects on Caribou habitat: VRI based ecosystem mapping plus structural stage succession processes analyses as basis for setting management objectives for Caribou habitat. Key area within the Klawli RMZ for the Wolverine Caribou Herd.	Required	Required	This issue requires re-measurement data over time
12. Parks management—to support new initiatives toward ecosystem-based parks management. Total Land Base management—to support assessing the contribution of unmanaged areas (parks and protected areas) in meeting FPC requirements or for other assessments. Mackenzie LRMP protected areas need to be included in VRI inventories. These are listed in Table 4.	Required	Supportive	VRI supports ecosystem mapping and further analysis to produce information using various indicators (e.g. ecosystem representation) for various decision processes, including within parks management and for total land base assessments over managed and unmanaged lands.

Table 4. List of Mackenzie parks and protected areas.

Type[4]	Name	
Ecological Reserve	Chunamon Creek E.R. Raspberry Harbour E.R.	Patsuk Creek E.R Blackwater Creek E.R.
Proposed Protected	Ed Bird Estella Lake Chase Muscovite Lake Heather Dina Lake Pine Pass	Ospika Cones Kwadacha Addition Omineca Frog-Gataga Finlay-Russell
Provincial Park	Bijoux Falls Tudyah Lake	Kwadacha Park Tatlatui

2.3 Summary of Inventory Issues

The following inventory issues were identified at the stakeholder meeting:

1. Check regenerated stand volume estimates from TIPSY models
2. Operability delineation
3. Quantify non-recoverable (gross) losses from beetle (Balsam, Pine and Spruce) infestations
4. Park inventories

[4] The total area of the Ecological Reserves, Protected Areas, and Parks is approximately 886,642 ha.

5. Check and update species composition labels for deciduous and mixed-deciduous stands
6. Confirm accuracy of Balsam loss factors and small Pine and Balsam taper equations
7. Elk winter range
8. The overall timber inventory still appears to be over-estimated despite a new photo interpretation (Phase I) inventory.[5]
9. Caribou corridors
10. Certification
11. Data management

2.4 VRI Activities and Products

The following VRI activities and products are needed to address the forest management issues in the District. These recommendations are based on the issues identified in Table 3 and Section 2.3, including the discussions at the stakeholders meeting.

1. Conduct a Phase I photo-interpretation over the entire District. The Phase I database will support timber-emphasis inventories, habitat mapping, ecosystem mapping, riparian mapping, and other applications over the District.

2. Conduct timber emphasis ground sampling in the Vegetated Treed area of the District, to provide statistically valid timber volumes and polygon-specific tree attributes. These data will support the timber supply review (TSR) in the Mackenzie TSA in 2006. (Deferred to 2010) The ground sampling will include Net Volume Adjustment Factor (NVAF) sampling to check loss factors and taper equations for the Balsam leading stands, and to check taper equations for the small Pine stands.

3. Conduct finer polygon delineation and timber emphasis ground sampling in the deciduous stands and mixed-deciduous stands in the DMK, to improve species composition descriptions and spatial data for these stands.

4. Install a monitoring program in the DMK, to provide baseline non-spatial data (timber, ecology and coarse-woody debris) for biodiversity purposes, and data on changes and trends over time of timber and non-timber resources. These change data could be used to check growth and yield predictions and to support future market certification requirements.

A preliminary strategic inventory plan to address the identified products so far is outlined in the next section.

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[5]A comparison of the new photo interpretation with the existing audit samples established in 1997 indicated that the volumes were still over-estimated: the ratio of ground volume to the inventory volume was approximately 0.8.

3. STRATEGIC INVENTORY PLAN

3.1 Overview

This section outlines a preliminary strategic inventory plan to develop specific VRI products discussed in Section 2.4. The VRI products include a new spatial vegetation inventory (Phase I) over the entire district landbase, a timber emphasis inventory in the vegetated treed landbase and the deciduous component, and a monitoring program over the entire district. These products can be obtained through completion of VRI photo interpretation, ground sampling and statistical adjustment.

3.2 Photo-Interpretation

3.2.1 Objective

The objective is to improve District polygon information – especially in areas where specific management issues occur—using photo interpretation. These issues include inadequate inventories for decision making especially in the northern third of the TSA and no statistically based ground sampling. The VRI product is a spatial database consisting of unadjusted photo-interpreted estimates. Ground sampling, used to check and adjust the photo-interpreted estimates, is discussed as a separate process (Section 3.3).

3.2.2 Target Area

Since the latter years the FRBC program VRI has occurred in different locations throughout the TSA and in separate operating areas. Refer to VRI Progress Map, attached. And now, since the near final Bill 28 agreement with BCTS, Abitibi has completed, or has various stages of completed VRI on a majority of their license area. The remaining areas in the District should be updated through a Phase I new photo-interpretation (Section 3.2.4). Priority areas, for Abitibi, include the northern third of the TSA from the top of Williston Reservoir to the northwestern boundary of the TSA. Some of the valley bottoms require acquisition of new photography while others are in various stages of completion. Refer to VRI Progress Map, attached. Sections of the northern portion have been updated with new inventory in recent years funded by the Forest Investment Account. The stakeholders will determine the methods for new photo-interpretation.

3.2.3 Target Attributes

All attributes listed on the VRI photo interpretation attribute form should be targeted. These attributes should be interpreted to the VRI photo-interpretation standards.

3.2.4 Methods

The Phase I information will be obtained using a combination of new aerial photography, (colour 1:30,000) conventional 1:15,000 scale black and white photos (where available), and scanned imagery. Bio-terrain mapping and ecological mapping (e.g. predictive ecosystem mapping), if available, may provide estimated data in addition to the Phase I.
Acquisition of new aerial photography is essential to support Phase I VRI photo-interpretation and spatial mapping in the DMK.

3.3 Timber Emphasis Inventory—Vegetated Treed Areas

3.3.1 Inventory Objectives

The proposed objective of the timber emphasis inventory is to:

> *Install adequate samples to adjust the timber inventory in the Vegetated Treed (VT) areas of the District, to achieve a sampling error of + - 10% (95% probability) for overall net timber volume in the VT area, and reasonably accurate individual polygon adjusted estimates.*

Stakeholders agreed to focus the sampling over the entire VT areas rather than the timber harvesting landbase (THLB) because most (80%) of the VT area is in the THLB. This approach also eliminates the problems associated with weighting data if disproportionate numbers of samples were used in the THLB and the non-THLB of the VT areas. Net timber volume is gross volume less stumps, tops, decay, waste, and breakage. Decay and waste will be estimated using VRI call grading/net factoring and NVAF sampling. Breakage will be estimated using existing loss factors.

3.3.2 Target Population

The target population would be the District VT landbase (forested land) (Table 2).

3.3.3 Sample Size

An estimated minimum of 140 sample clusters[6] should be installed in the VT area. These samples would be distributed among leading-species strata proportional to their area (Table 5). The proposed minimum sample size would achieve a sampling error of approximately + - 7% (95% probability) for net timber volume in the VT area, assuming an estimated coefficient of variation (CV) of approximately 41%.

Table 5. Approximate distribution of plots.

Leading Species	Area (%)	Number of plots
Lodgepole Pine	36.6	51
Spruce	31.5	44
Balsam	24.9	35
Other*	7.1	10
Grand Total	**100.0**	**140**
*Aspen, Birch, Cottonwood, Douglas Fir.		

3.3.4 Sampling Approach

VRI Timber Emphasis Plots (TEP) should be used to gather data following the current VRI Ground Sampling Manual. The measurements would include timber attributes and coarse woody debris (CWD). These TEPs would provide a sampling framework for additional sampling, such as monitoring (where a subset of the TEPs would be re-measured over time.

3.3.5 Sample Selection

Sample polygons would be selected using the MOFs standard stratified probability proportional to size with replacement (PPSWR) sampling method.

3.3.6 Net Volume Adjustment Factor Sampling

NVAF Sampling should be conducted to adjust net volume. This sampling provides factors to adjust net tree volume estimated using net factoring and taper equations. The adjustment accounts for hidden decay and possible taper equation bias. NVAF sampling involves:

- Detailed stem analysis of sample trees
- Calculation of actual net volume
- Calculation of the ratio between actual net volume and estimated net volume

Table 6. NVAF sample locations and trees.

Leading Species	Number of Trees (Sample Locations)			
	Immature	**Mature**	**All ages**	**Total**
Conifer*	30 (10)	30 (12)	-	60 (22)
Small Pine	-	-	30 (8)	30 (8)
Balsam	-	30 (10)	-	30 (10)
Deciduous	-	30 (10)	-	30 (10)
Non-VT	-	-	10 (4)	10 (4)
Dead	-	-	10	10
Grand Total	**30 (10)**	**90 (32)**	**50 (12)**	**170 (54)**
* Includes Pine, Spruce, and Balsam; a deciduous component is included in immature stratum.				

[6] The minimum sample size increased from 125 (as previously discussed at the stakeholder meeting) to 140 because of changes in the leading-species relative areas (Table 2).

[7] This CV is for the ratio of actual volume to estimated volume, and inflated by 25% (to account for differences in the VRI and inventory audit plot-cluster designs). The actual volume is based on the 47 inventory audit plots installed in 1997 and the estimated volume is based on the new Phase I.

Estimated net volume is obtained from net factoring and taper equations. The stakeholders agreed that at least 170 trees (160 live, 10 dead) selected from 54 locations should be selected and destructively sampled for NVAF (Table 6).

3.3.7 Within Polygon Variation Sampling (WPV) – (optional)

WPV sampling indicates what should be expected in a field inventory "check". It also provides information to estimate individual polygon error, assessed as the difference between adjusted polygon value and "true" value for that polygon based on intensive sampling of sample polygons. Approximately 30 polygons should be selected from the target population (or from the TEP plots) and intensively cruised using a combination of 20-50 full measure and count plots (ratio 1:4) per sample polygon. The measurements should focus on gross volume (no net factoring or call grading) and site index.

3.3.8 Implementation

The timber inventory should be coordinated with photo-interpretation work and be implemented as follows:

- Step 1—a small batch of sample clusters (e.g., 40) should be installed over the target population in the first field season (or first half of field season). Re-calculate the sample size based on new CV estimates.
- Step 2—install remaining plots in the second field season (or the second half of a field season), if required.

A VPIP for ground sampling should be developed following MOF guidelines in *Vegetation Resources Inventory Guidelines for Preparing a Project Implementation Plan for Ground Sampling.*

3.4 Implementation Strategy

The stakeholders will identify project implementation priorities. The District may lead this initiative. The District and Region will coordinate stakeholder efforts to develop multi-year VPIPs based on VSIPs for submission to FIA or other funding agencies. VPIPs identify inventory activities, priority areas, annual costs, and roles and responsibilities for implementation.

3.5 Costs

Estimated sample sizes and preliminary costs for the District VRI activities are listed in Table 7. More accurate and detailed costs should be included in the VPIPs.

Table 7. Estimated sample sizes and costs for VRI in the DMK.

VRI Activity	Sample Size	Unit Cost ($)	Total Cost ($)
Photo Interpretation			
a) **Photography**[11]	4.75M ha	0.12	570,000
b) **Photo new**	6.41mha	1.00	6,410,000
Total Photo Interpretation			***6,980,000***
Ground Sampling			
c) **TEP**[12] **–Vegetated Treed**			
Phase II Clusters	140	1,500	210,000
NVAF sampling (trees)	170	500	85,000
WPV sampling (polygons)	30	1,500	45.000
Total Ground Sampling			***340,000***
Other Costs			
Quality assurance (10% of ground sampling cost)[13]			54,500
Project management (20% of ground sampling cost)[14]			109,000
Statistical Analysis			20,000
Total Other			***183,500***
Grand Total			***7,503,500***

[11] The total cost of the photography (1:30,000 colour) is broken down as follows: Parks, Protected Areas and Ecological Reserves (886,642 ha) $106,397; Wildland RMZ (1,127,751 ha) $135,330; and Enhanced, special and General RMZ's (2,736,257 ha) $328,350. The total area listed here is 4,750,650 ha which was rounded to 4.75 million ha in Table 7.

[12] Timber emphases VRI ground sampling.

[13] The quality assurance is for ground sampling only (not photo interpretation). It is done by a check-cruiser, and it involves checking 10% of the field crew work using the MOF quality assurance procedures and standards.

[14] These project management costs are for ground sampling; they will vary by project and how projects are managed (e.g. projects may be managed in-house).

4. STAKEHOLDERS AND SIGNATURES

Table 8. List of stakeholders in the DMK.

Agency	*Participant*
MOF Mackenzie Forest District	Dave Francis, RPF, District Manager
	Signed
Northern Interior Forest Region	Dick Nakatsu, Resource Inventory Specialist
	Signed
Forest Analysis and Inventory Branch	Jon Vivian, Manager – VRI
	Signed
BC Parks Service	Jim Hesse, BC Parks
	Signed
Forest Companies	
Canadian Forest Products	Randy Hart, RPF, Manager Forestry and Planning
	Signed
Abitibi Consolidated Company of Canada.	Wayne Lewis, RPF, Woodlands Manager
	Signed

Mackenzie TSA
Vegetation Resources Inventory Strategic Inventory Plan

It is the intention of the proponent to implement the Mackenzie TSA Vegetation Resources Inventory Strategic Inventory Plan (VSIP) as described, however it is recognized that uncertainty in the acquisition of suitable aerial photography limits the proponents ability to determine a schedule at this time. Vegetation Resources Inventory Project Implementation Plans (VPIP), which build upon the information provided in the VSIP, will require detailed implementation schedule information.

I have read the Mackenzie TSA Vegetation Resources Inventory Strategic Inventory Plan (VSIP), and am satisfied that it meets current Vegetation Resources Inventory (VRI) standards and Ministry of Forests and Range (MOFR) business needs.

original signed

Jon Vivian, R.P.F. date
Manager,
Vegetation Resources Inventory Section,
Forest Analysis and Inventory Branch,
Ministry of Forests and Range

APPENDIX II—GLOSSARY OF TERMS

Change Monitoring Inventory

Change Monitoring Inventory (CMI) is the process of estimating and monitoring the change over time in timber and non-timber attributes, based on repeated measurements of the same objects over a time series. The MOF&R Forest Analysis and Inventory Branch is currently implementing the CMI over the province. The provincial procedures can also be deployed to address management-unit level monitoring objectives.

Ground Sampling

Ground sampling is the field measurement of timber, ecology, range, and/or coarse woody debris values at one or more locations within each sample polygon. Sample polygons are selected using the probability proportional to size with replacement (PPSWR) method. To accommodate a wide variety of resources, various types and sizes of sampling units (e.g., fixed and variable plots, transects) are used to make the measurements.

Inventory Unit

An inventory unit is the target population from which the samples are chosen. The inventory unit could be a specific geographic area (e.g. TFL or TSA) where a specific set of attributes is needed. The size of the inventory unit depends upon the sampling objectives.

Landcover Classification

The BC Land Cover Classification Scheme (BCLCS) was designed specifically to meet VRI requirements, in addition to providing general information useful for "global vegetation accounting" and "integrated resource management." The BCLCS is hierarchical and reflects the current state of the landcover (e.g., presence or absence of vegetation, type and density of vegetation) and such fixed characteristics as landscape position (i.e., wetland, upland, alpine). There are two main classes of polygons: Vegetated and Non-Vegetated.

Management VRI

Management VRI are specialized inventories that provide detailed information required for specific resource management, i.e., day- to- day forest management. One or more VRI sampling procedures may be used for management inventories. Management inventories may focus on specific resource types (e.g., timber, range, ecology), geographic areas (e.g., landscape unit, TFL), attribute sets (e.g., Douglas Fir leading stands, age class 4+). They may use one or more of the following tools (e.g., photo-interpretation, ground sampling, NVAF sampling).

National Forest Inventory (NFI)

The NFI provides information on Canada's resources across all provinces and allows the Federal Government a consistent framework for reporting on Canada's inventory, including reporting on the Criteria and Indicators and the Kyoto protocols. The inventory unit for the NFI is the entire country, although it is implemented province-by-province. BC's provincial CMI system will provide the data needed for the NFI as well as provincial reporting.

Net Volume Adjustment Factor (NVAF) Sampling

NVAF sampling provides factors to adjust net tree volume estimated from net factoring and taper equations. The adjustment accounts for hidden decay and possible taper equation bias. NVAF sampling involves detailed stem analysis of sample trees, calculation of actual net volume, and calculation of the ratio between actual net volume and estimated net volume (where estimated net volume is obtained from net factoring and taper equations). The NVAF (and VRI net factoring) replaces the existing loss factors for inventory applications. It does not, however, replace the loss factors for revenue applications.

Photo-Interpretation

Photo-Interpretation involves subjective delineation of polygons and photo estimation of attributes for all polygons in an inventory unit. Medium scale aerial photographs (1:15,000) are most often used in photo-interpretation. However, if existing photo-based inventory is acceptable, the database can be translated into VRI format and upgraded to include the additional VRI attributes.

Post-Stratification

Post-stratification involves dividing inventory unit into mutually exclusive sub-populations (strata) *after* ground sampling has been completed. Samples that fall in each post-stratum are analyzed separately and the results are applied to the corresponding population post-strata to improve the precision of the inventory's overall averages and totals.

Pre-Stratification

Pre-stratification divides an inventory unit into mutually exclusive sub-populations (strata) *before* ground sampling to provide estimates for specific areas, or to increase the confidence in the overall estimates by considering special characteristics of each stratum.

Resource-Specific Interpretations

Resource-Specific Interpretations (RSI) use the Resource Inventory Committee (RIC) standard VRI baseline data products (provincial CMI or management inventory), in combination with other data sets and analysis (outside of that required to produce VRI), to produce information to address specific –resource management issues (e.g., TSR review, important ecosystems and habitats). These interpretations include ecosystem interpretations and habitat interpretations.

Sample Size

The sample size for an inventory is the minimum number of ground samples to be established in an inventory unit to meet the target precision.

Statistical Analysis

Statistical analysis or adjustment is the process of adjusting the values of the photo-interpretation variables using ground-sampling observations. Ground observations are compared to photo-estimated values to develop adjustment factors by species groups. These factors are then applied to the polygons in the photo interpretation database to produce the final adjusted database.

Sub-unit

Sub-unit describes the inventory unit within an Inventory Unit. For example, if the inventory unit is defined as the Vegetated Treed area in a Forest District, then a sub-unit may be defined by a specific geographic area (e.g., operable landbase) or stand type (e.g., problem forest types) within the Vegetated Treed area in the Forest District.

Target Precision

Target precision expresses the amount of variation in key attributes (e.g., timber volume) desired in the final results. Target precision, usually expressed as the coefficient of variation (CV), is used to calculate the minimum sample size for subsequent ground sampling. The current target precision for timber volume is $\pm$10% (90% or 95% probability); stakeholders define the probability (uncertainty) level.

Vegetation Resources Inventory (VRI)

VRI is an improved vegetation inventory process for assessing quantity and quality of BC's vegetation resources. The VRI process is designed to include a flexible set of sampling procedures for collecting vegetation resource information. The VRI is essentially a toolbox for procedures, which include:

- *Photo-Interpretation:* the delineation of polygons from aerial photography and the estimation of resource attributes.
- *Ground Sampling:* the establishment of plot clusters in selected polygons to measure timber, ecological, and /or range attributes.
- *NVAF Sampling:* stem analysis sampling of individual trees for net volume adjustment.
- *WPV Sampling:* intensive sampling of selected polygons to determine the error between the estimated attribute values and the "true" attribute values.
- *Statistical Adjustment:* the adjustment of the photo-interpreted estimates for all polygons in an inventory unit or management unit using the values measured during ground sampling.

The VRI can be deployed over the entire province measuring timber and non-timber resources, or over a large management unit (management VRI) measuring selected resources in specific portions of the landbase. The VRI Sampling process produces spatial and non-spatial databases that can be used in multiple resource management applications including timber, ecosystem, and wildlife habitat management.

Within Polygon Variation Sampling

WPV sampling provides information for expressing the true individual polygon error, assessed as the difference between the adjusted polygon value and the "true" value for that polygon. The "true" value for the polygon is an estimate derived from a small sample of polygons that are intensively sampled on the ground.

VRI Progress Map

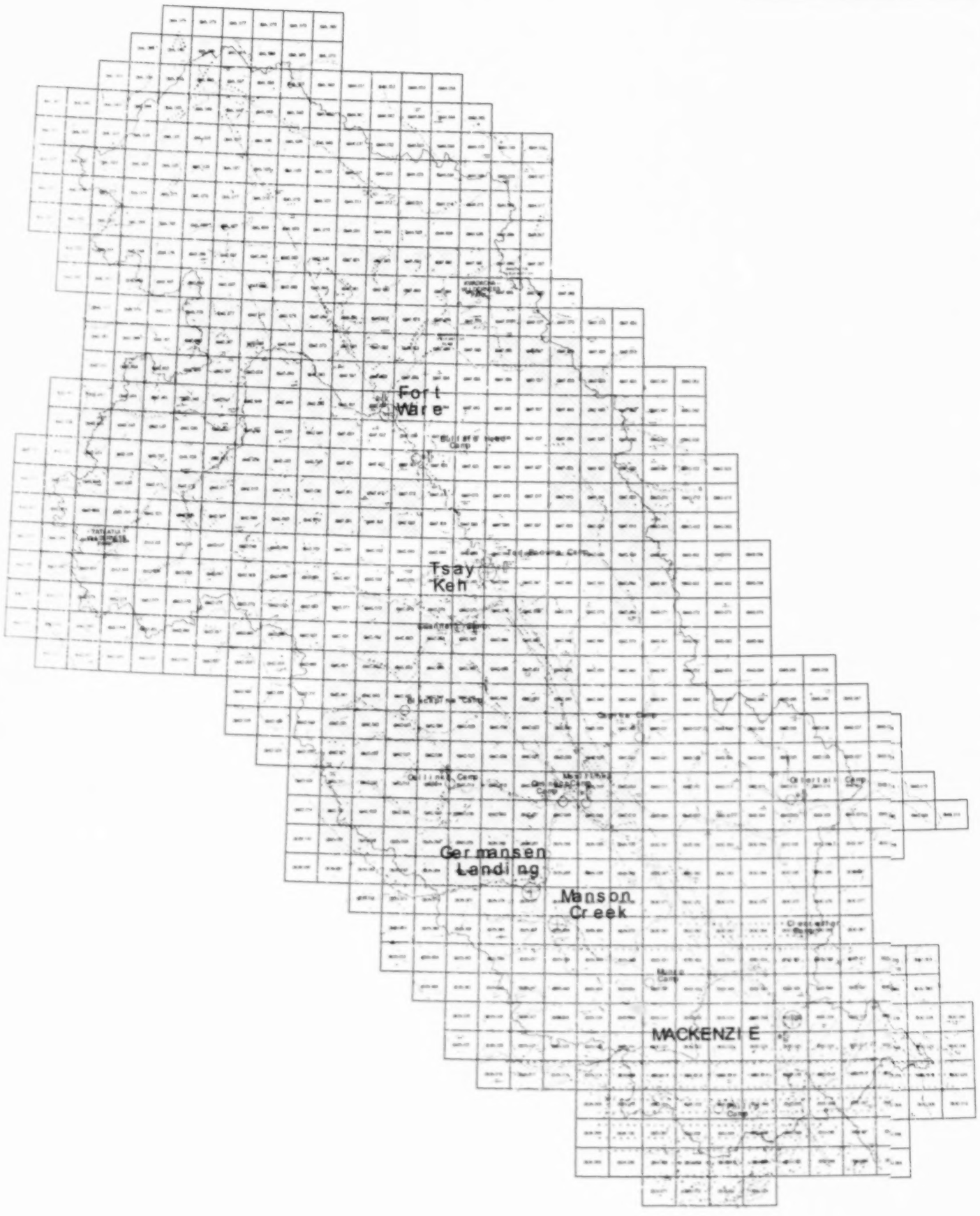
Mackenzie Timber Supply Area

August 26, 2005

ABITIBI CONSOLIDATED

Legend

- 2004 1:30,000 Colour Photography
- VRI Completed
- DIAP Setup Completed
- Wilderness Area
- Delineation Only



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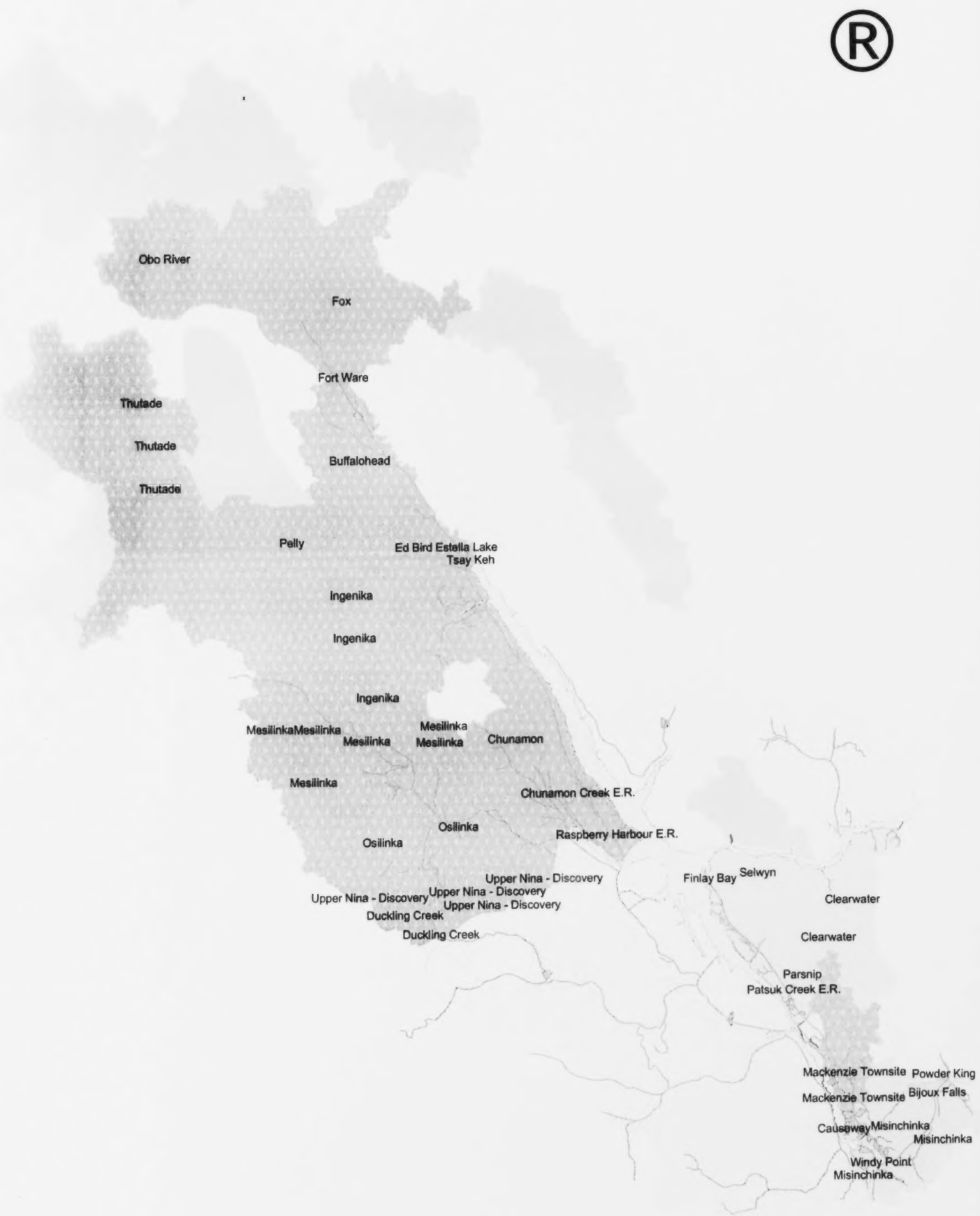

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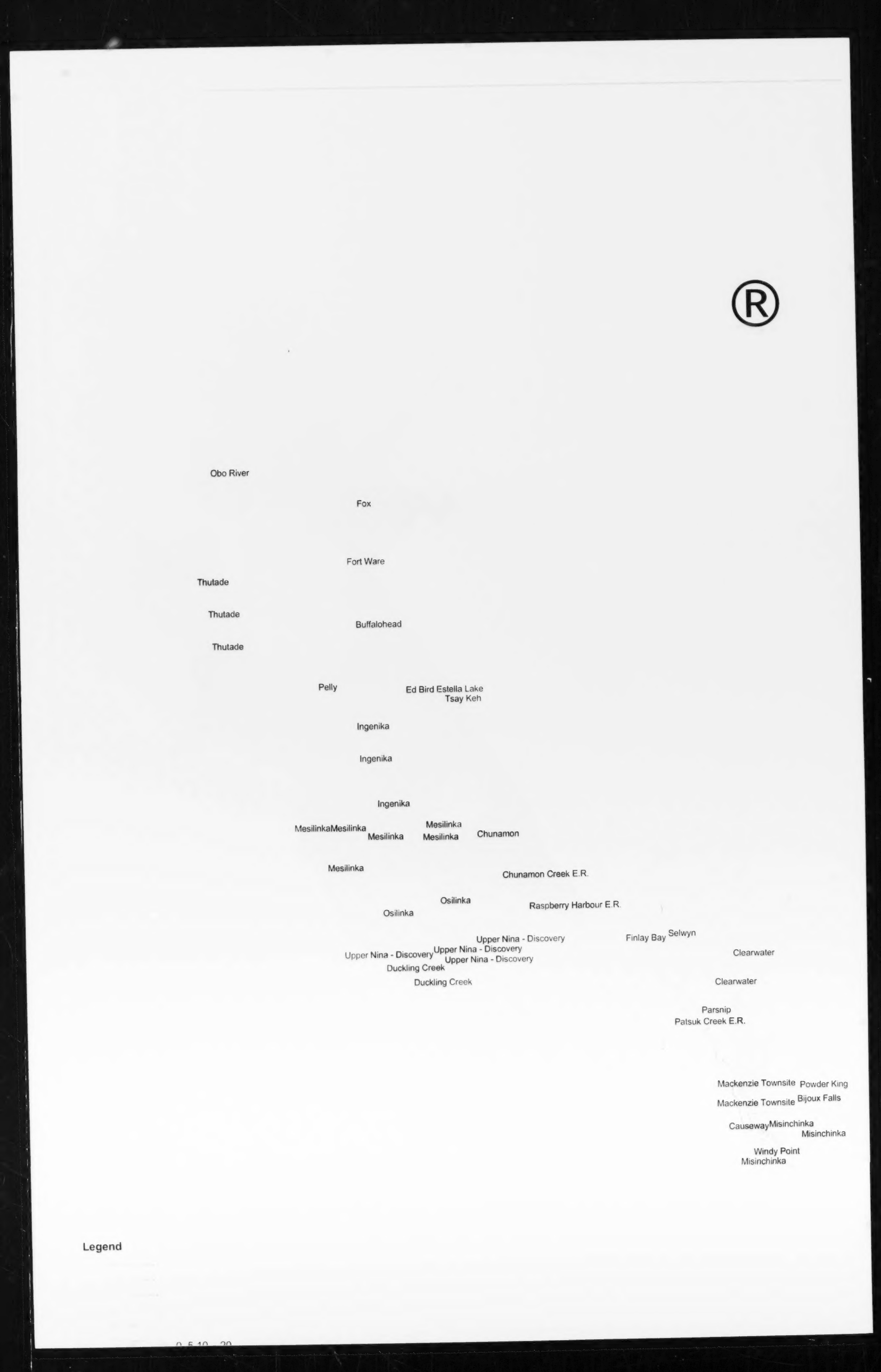
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Fox
Fort Ware
Thutade
Thutade
Buffalohead
Thutade
Pelly
Ed Bird Estella Lake
Tsay Keh
Ingenika
Ingenika
Ingenika
MesilinkaMesilinka
Mesilinka
Mesilinka
Mesilinka
Chunamon
Mesilinka
Chunamon Creek E.R.
Osilinka
Osilinka
Raspberry Harbour E.R.
Upper Nina - Discovery
Finlay Bay
Selwyn
Upper Nina - Discovery
Upper Nina - Discovery
Upper Nina - Discovery
Clearwater
Duckling Creek
Duckling Creek
Clearwater
Parsnip
Patsuk Creek E.R.
Mackenzie Townsite
Powder King
Mackenzie Townsite
Bijoux Falls
CausewayMisinchinka
Misinchinka
Windy Point
Misinchinka
Legend